THE SPLIT-BRAIN SYNDROME: AN EXAMPLE OF THE PHILOSOPHICALLY PUZZLING BEHAVIOR RESULTING FROM COMMISSUROTOMY

Although there were earlier studies and research is conducted elsewhere, the most extensive psychological studies of split-brain patients have been done by Roger Sperry and his coworkers at the California Institute of Technology. The subjects involved in this research are patients of J. E. Bogen, of the Ross-Loos Medical Group, and P. J. Vogel, Chief of Neurosurgery at the White Memorial Medical Center in Los Angeles. As of 1974, sixteen commissurotomies had been performed in a series which began in the early 1960s; but the sample involved in the psychological studies is closer to six, chosen in part because they had minimal brain damage other than that directly linked to the operation.

The operation, which consists of the sectioning of the corpus callosum and other minor commissures linking the two cerebral hemispheres,[6] is undertaken for the relief of uncontrollable epilepsy. Medically, it is considered a success. Epileptic attacks became less frequent, were confined to one hemisphere, or disappeared entirely. In fact, Sperry assures us that "a person two years recovered from the operation and otherwise without complications might easily go through a routine medical checkup without revealing that anything was wrong to someone not acquainted with his surgical history."[7]

The psychological result is less clear. After recovery from the operation, the patients' behavior is, by and large, normal. If you knew them before the operation, you would not notice any dramatic changes in their intellect, personality, or day-to-day behavior. It is not just that such observation is likely to be too casual to detect a difference. In a number of clinical papers published in the

1940s, Akelaitis [8] recorded his failure to find any interesting psychological result attributable to a series of partial and total commissurotomies. This surprising lack of effect prompted McCulloch's pessimistic remark that the sole function of the corpus callosum was to transmit epileptic seizures from one hemisphere to the other. [9] Yet, under controlled conditions, the behavior of split-brain patients is decidedly abnormal. When input is limited to, and response demand placed on, one of the hemispheres, it has seemed to various experimenters that they were dealing with "two separate spheres of conscious awareness, two separate conscious entities or minds running in parallel in the same cranium, each with its own sensations, perceptions, cognitive processes, learning experiences, memories, and so on." [10]

The abnormal behavior of split-brain patients in such controlled conditions is illustrated by the following. A subject, S, is told to fixate a point on a screen before him. 'Key ring' is flashed on the screen for a tenth of a second, with 'key' appearing to the left of the fixation point and 'ring' to the right. Since the time is too brief for eye movement, information from the right visual field ('ring') is projected exclusively to the left hemisphere and information from the left visual field ('key') is projected exclusively to the right hemisphere.[11] If S is asked to say what he saw, he responds that he saw 'ring.' Questioned about what kind of ring, he is as likely to say that it is a wedding ring, a boxing ring, the ring of a bell, as that it is a key ring. S's verbal responses show no awareness of 'key.' On the other hand, if S is instead asked to retrieve, with his left hand, what he saw from an array of items (concealed from sight), he will retrieve a key while rejecting all varieties of rings. Similarly, if S is asked to point with his left hand to what he saw, he will point to a key (or a picture of a key) and not to a ring (or a picture of a ring). S's response with his left hand indicates an awareness of 'key,' but none of 'ring.' If S is asked to sort through an array of items (concealed from sight) with both hands and pick out what he saw, the right and left hands work

independently. The right hand will pick up and reject a key before settling on a ring; the left will pick up and reject a ring before settling on a key. In general, when the response demanded is controlled by the left hemisphere, it indicates that S was aware of 'ring' and unaware of 'key'; when the response demanded is controlled by the right hemisphere, it indicates that S was aware of 'key' and unaware of 'ring.' Someone seems to have seen 'key' and someone seems to have seen 'ring' and they seem unaware of each other. No one is aware of seeing 'key ring.'

One other feature of our example is worth remarking on. Even the simple tasks demanded of the minor[12] hemisphere implicate a wide range of psychological functions. The instructions to pick out what is named must be perceived and understood, 'key' must be perceived and understood to name keys, the key must be identified by touch, and so on. According to Sperry,[13] the performance of such a task is beyond the capacity of a chimp; the range and integration of functions demanded is characteristically human.

The standard explanation of the sort of behavior exhibited is roughly as follows: The left half of the field of vision is conveyed to the right side of the brain, and vice versa. Thus the right brain sees only the word 'key' and the left brain sees only the word 'ring.' The right brain is mute, and so the oral response to the question, by the left brain, reports only what the left brain saw, the word 'ring.' The left hand is controlled by the right brain; so it points to what is named by the word the right brain saw, a key. In discussion of such experiments, the right and left brain are commonly said, with varying degrees of caution, to see, reach, remember, and the like. They are thus treated as subjects of experience, i.e., as separate persons. And the explanation for the failure to elicit any response suggesting that 'key ring' has been or is known to have occurred is that the subjects of the two experiences, the seeing of 'key' and the seeing of 'ring,' are not the same and not, because of sectioning of the corpus callosum and the experimental controls, in communication with each other. [14]

With suitable controls, it is also possible to confine input from the other senses, except taste, to a single hemisphere. The abnormalities in the behavior of split-brain patients that arise when input is limited to, and response demand placed on, one hemisphere have now been extensively mapped. These abnormalities constitute the bulk of "the syndrome of the neocortical commissures" or, as I shall call it, the split-brain syndrome.[15] The extent of the abnormalities exhibited varies with the type of surgery the patient undergoes, with whether the corpus callosum and all the minor commissures are totally severed.[16] Even when the corpus callosum and the minor commissures have been completely sectioned, as for all of Vogel and Bogen's patients, there are sizable individual differences among patients; and there are equally sizable differences between the immediate postoperative behavior of individual patients and their later behavior.[17] One patient, for example, was able to read across midline seven years after the operation, although he was unable to do this postoperatively. So, seven years after the operation, this patient would not even exhibit the kind of behavior illustrated in the "key ring" example. Fortunately, the fine grain of empirical fact, as well as its markedly individual character, is largely irrelevant to my philosophical purposes. Accordingly, I will treat all split-brain patients as though they had a complete commissurotomy and exhibited the complete syndrome. The "key ring" experiments will be used throughout to illustrate the kind of behavior that leads to philosophical difficulties.

HOW TO GENERATE PHILOSOPHICAL PROBLEMS ABOUT SPLIT-BRAINS

Behavior of the sort illustrated by the "key ring" experiment is the starting point for a chain of inferences which generates the philosophical problems that are my main concern. The most important steps along the way are: